From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* see form PCT/ISA/210 (second sheet)	
Applicant's or agent's file reference see form PCT/ISA/220	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2004/042941	21.12.2004	22.12.2003

International Patent Classification (IPC) or both national classification and IPC
F28F9/04, B01D63/02, F28D7/00, B01D69/08, B01D71/32, B01D65/00, D01D5/247

Applicant
MYKROLIS CORPORATION

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA"). However, this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of three months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This opinion has been established on the basis of a translation from the original language into the following language , which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ in written format

   ☐ in computer readable form

   c. time of filing/furnishing:

   ☐ contained in the international application as filed.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees, the applicant has:

   ☒ paid additional fees.

   ☐ paid additional fees under protest.

   ☐ not paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with

   ☒ not complied with for the following reasons:

   see separate sheet

4. Consequently, this report has been established in respect of the following parts of the international application:

   ☒ all parts.

   ☐ the parts relating to claims Nos.

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4,5,12,15,19,22-29,31,32,35,36
	No:	Claims	1-3,6-11,13,14,16-18,20,21,30,33,34
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-36
Industrial applicability (IA)	Yes:	Claims	1-36
	No:	Claims	

2. Citations and explanations

   see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item IV.

This Authority considers that there are 3 inventions covered by the claims indicated as follows:

I: Claims 1-14,15,21-29
Exchanger with hollow conduits with improved interconnection and integrity of tube sheet and housing by providing grooves at the end of the housing which are filled by the potting material and which comprise vent channels to prevent inclusion of gas.

II: Claims 16-20,35
Exchanger with hollow conduits potted in a tube sheet, the conduits comprising co-extruded layers. The outer layer of the conduits is fused with the tube sheet material in order to improve bonding strength and sealing properties of the connection.

III Claims 30-34,36
Exchanger with hollow conduits at a packing density of 20-70 % Vol. capable to withstand pressures of about 3,4 bar and temperatures of 100 °C without loosing its integrity.

They are not so linked as to form a single general inventive concept (Rule 13.1 PCT) for the following reasons:

The first invention is directed to the connection of housing and tube sheets (without neither concerning the problem of connecting the tubes to the tube sheet nor with respect to any limiting process conditions), the second to the sealing of the conduits in the tube sheet (without neither concerning the problem of improving the connection between the tube sheets and housing nor with respect to any limiting process conditions), the third invention is directed to an exchanger generally being capable to operate at the respective process conditions (without disclosing the special technical features of inventions I and II). Neither the combinations of the essential features nor the inherent problems to be solved (and consequently also the corresponding solutions thereof) of groups of inventions are linked in a way to form a single general inventive concept. Furthermore there is no technical connection within the solutions of the different inventions which gives expression to

common inventive features. Thus the present application does not fulfil the requirement of rule 13.1 PCT.

Re Item V.

1 Reference is made to the following documents:

D1: EP-A-0 706 818 (KANEGAFUCHI KAGAKU KOGYO KABUSHIKI KAISHA) 17 April 1996 (1996-04-17)

D2: PATENT ABSTRACTS OF JAPAN vol. 1997, no. 01, 31 January 1997 (1997-01-31) -& JP 08 229359 A (KANEGAFUCHI CHEM IND CO LTD), 10 September 1996 (1996-09-10)

D3: WO 03/029744 A (MYKROLIS CORPORATION; DOH, CHA, P; CHENG, KWOK-SHUN; BRIGGS, ALICIA) 10 April 2003 (2003-04-10)

D4: WO 03/029775 A (MYKROLIS CORPORATION; PILLION, JOHN, E; SHYU, JIEH-HWA; BRIGGS, ALICIA) 10 April 2003 (2003-04-10)

D5: PATENT ABSTRACTS OF JAPAN vol. 017, no. 355 (C-1079), 6 July 1993 (1993-07-06) -& JP 05 049875 A (MITSUBISHI RAYON CO LTD), 2 March 1993 (1993-03-02)

D6: US-B1-6 582 496 (CHENG KWOK-SHUN ET AL) 24 June 2003 (2003-06-24)

D7: US-A-6 149 422 (CESARONI ET AL) 21 November 2000 (2000-11-21)

D10: EP-A-0 941 759 (NEDERLANDSE ORGANISATIE VOOR) 15 September 1999 (1999-09-15)

INVENTION I

2 Novelty - Invention I

The subject matter of the independent **claims 1, 7, 21 and 25** discloses an exchanger for mass and/or heat comprising the following features:

I) thermoplastic housing bonded by means of

ii) a thermoplastic resin (sleeve resp. tube sheet) to

iii) hollow conduits,

iv) which can be made of a thermoplastic (*only claims 7, 21 and 25*)

v) an inner portion of the housing comprising "structures", where ii) is bonded to

vi) the structures can be "grooves" (*only claim 1*),

vii) the conduits are potted at both ends (*only claims 7, 21, 25*)

2.1 The subject matter of **claims 1-3, 6-11, 13, 14 and 21** is not novel over D5 and thus fails to fulfil the requirements of Article 33(2) PCT.

D5 discloses a mass exchanger with thermoplastic hollow fibres (polyethylene) and a thermoplastic housing (polycarbonate) (see §[0014] of the computer translation provided by the Japanese Patent Office) wherein the fibres (2) are bonded into a tube sheet (4) and the tube sheet is fixed to the housing (1) by means of several grooves (1-1). The fibres are subsequently opened (fig.3).

2.2 The subject matter of **claims 1, 7, 8, 10, 11, 13, 14 and 21** is not novel over D1 and thus fail to fulfil the requirements of Article 33(2) PCT.
D1 discloses a mass exchanger comprising a wedge type protrusion to mechanically lock the tube sheet (B) to the housing (2). Both fibre ends may be potted (col.7, ll 34-38). The fibres and the housing are made of thermoplastics (col.6, ll 16-30).
Moreover, D1 discloses that the use of grooves instead of protrusions is state of the art (col.1, ll 31-35).

2.3 D2 discloses the same features as D1 but in addition a figure of an exchanger with two tube sheets (see fig. abstract).

3 Inventive step - Invention I

3.1 The subject matter of claims 4, 12 and 24 are distinguished from the closest prior art document D5 by the venting slots interconnecting the several grooves. D5 already addresses the problem of venting of the grooves as it discloses that an angle of at least 3° has to be foreseen in order to prevent that resin is excluded from a groove (see § [0008] of the computer translation of the Japanese Patent Office).

The problem to be solved is to prevent the encapsulation of gas during the potting process which would lower the mechanical integrity of the tube sheet by means of an alternative method.

An alternative solution is given by D1. Here the wedge-type protrusions have a means for degassing in forms of interconnecting vent slots (fig.1-6, ref.5 and col.3, ll 45-51). The use of venting slots is thus already known and is in addition not limited to the type of structure (internal of external to the housing wall).

Therefore the subject matter of **claims 4, 12 and 24** does not fulfil the requirements of Article 33(3) PCT.

3.2 The subject matter of claims 5 and 15 is distinguished to the closest prior art document D5 by the use of perfluorinated compounds.

The problem to be solved is to improve the chemical integrity of the device.

The solution is obvious from D6. D6 discloses uses of an exchanger device as given in the application (wafer coating, semiconductor manufacturing). According to the teaching of D6 (col.2, ll 19-47) an exchanger completely made of perfluorinated compounds would be suitable for such problems.

Also D3 or D4 (same applicant) provide the information, that perfluorinated compounds are suitable to solve the problem.

Thus the subject matter of **claims 5 and 15** does not fulfil the requirements of Article 33(3) PCT.

3.3 The subject matter of claims 22, 23 and 25-29 differs to the closest prior art document D4 in that no "structures" are provided (the process is known from D4, fig.1)

The problem is to improve the mechanical integrity of the exchanger.

The solution to this problem is obvious either from D1 or D5.

Thus the subject matter of **claims 22, 23 and 25-29** does not fulfil the requirements of Article 33(3) PCT.

INVENTION II

4 Novelty - Invention II

The subject matter of the independent **claim 16** discloses an exchange device comprising the following features:

a) thermoplastic housing fused by means of
b) a thermoplastic resin (sleeve resp. tube sheet) forming a sleeve to
c) hollow conduits made of
d) a thermoplastic
e) and co-extruded,
f) said fusing made at both ends of the said conduits.

The subject matter of **claims 16-18 and 20** is not novel over D7 and thus fails to fulfil the requirements of Article 33(2) PCT.
D7 discloses an exchanger made e.g. from fluorocarbon polymers (col.6, l.48), wherein the tubes can be co-extruded to allow for bonding of the outer layer with a tube sheet being part of a plastic heat exchanger(col.2, ll 57-62). Fluid fittings for the shell-side fluid are commonly applied via fittings in the vessel.

5 Inventive step - Invention II
The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claims 19 and 35** does not involve an inventive step in the sense of Article 33(3) PCT.

5.1 The differing feature to the subject matter of **claim 19** is, said D7 does not disclose a thermally conductive material added to the conduits. It has to be noted in that context that the wording "thermally conductive material" is vague (Article 6 PCT and guidelines C III 4.5) as it would be difficult for certain materials to interpret wether or not they would fall in this category.

However, the problem to be solved is to increase the heat transfer coefficient in a plastic exchanger device.

The solution is provided by the teaching of D3 which suggests to impregnate the conduits with a thermally conductive material (see D3, cl.8&16).

Therefore the subject matter of **claim 19** does not fulfil the requirements of Article 33(3) PCT.

5.2 It is not clear what problem is solved by the feature "co-extruded" for the subject matter of **claim 35**. Thus no inventive step can be acknowledged under Article 33(3) PCT.

INVENTION III
6 Novelty - Invention III

The subject matter of the independent **claim 30** discloses an exchange device comprising the following features:

A) hollow conduits being
B) potted and
C) capable of transferring heat, said device being integral at
D) a temperature of 100°C and
E) a pressure of 3.4 bar.
F) The packing density of the device is between 20 and 70%.

6.1 Feature C is regarded as being fulfilled for all tubular exchangers as heat can (for different material depending heat transfer coefficients) be transferred in any case.

6.2 The ranges D) and E) are not clear (see item VIII vi).

6.3 The subject matter of **claims 30-34** is not novel over D1 and thus fails to fulfil the requirements of Article 33(2) PCT.

The exchanger according to example 1 (D1) has a shell with an inner diameter of 61 mm (cf. comparative example 1) and comprises 3.400 potted hollow conduits having an outer diameter of 0.8 mm. The resulting packing density in terms of volume is thus 58%. The exchanger is capable of withstanding pressures of 24.51 bar and temperatures of 120°C **or more** (col.3, ll 40-44).

7 Inventive step - Invention III

7.1 The features of **claims 31 and 32** are process depending features but not apparatus features.

Moreover the exchange device is in no way limited to any materials or certain manufacturing methods. Thus the skilled man is able to design exchangers fulfilling in operation all of said parameters.

The apparatus according to each of D1 or D10 thus can be designed to fulfil said process parameters.

Finally the problem to be solved by said features is not clear.

For these reasons the subject matter of **claims 31 and 32** does not comply with the requirements of Article 33(3) PCT.

7.2 The subject matter of claim 36 specifies only the selection of the material for the hollow conduits for a device which already exhibits excellent heat and pressure resistance (see each of D1 or D10).

Presently it is unclear what problem is solved by the selection. In consequence the subject matter of **claim 36** fails to fulfil the requirements of Article 33(3) PCT.

Re Item VIII.

I The wording "conduits fluidly sealed by a thermoplastic resin" **throughout the claims** is ambiguous and thus not allowable under Article 6 PCT. It could be related to the ends of the conduits or to the permeability of the conduit walls.
However, what is obviously meant is that a tube sleeve is formed by a thermoplastic resin which embeds the hollow conduits in a fluidly sealed manner.

ii The varying apparatus features of independent **claims 1, 7, 21 and 25** render the claims unclear with respect to the features being essential to the invention.

iii The wording "**inner** layer thermally bonded to an **inner** layers" within claim 20 is obviously the result of a mistyping.

iv The back reference of "grooves" within **claim 24** is unclear as claim 21 does not disclose "grooves"

v The process defined within the subject matter of **claims 25-29** is not clear. It is neither defined if heat or mass is transferred, nor what the object of the process is and what a "substrate" might be.

vi The wording "integral at a temperature of at least 100°C and a pressure of at least 50 psig" in **claim 30** ambiguous as it is readable as "integral at a temperature ≥ 100°C

and a pressure ≥ 50 psig" which ranges are lacking a feasible upper limit.